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Herding and Hillforts in the Bronze and Iron Age Eastern Adriatic: Results of the 2007-2010 Excavations at Gradina Rat

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The development and function of Bronze and Iron Age hillfort settlements along the eastern Adriatic is still little understood. In the interest of adding to the understanding of these sites, the fauna of the central Dalmatian site of Rat is examined to deduce changes in hunting, husbandry practices and carcass processing over its occupation sequence. Material is compared

Stočarstvo i gradine na istočnom Jadranu u brončano i željezno doba: rezultati iskopavanja na gradini Rat 2007.-2010.

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Razvoj i uloga brončanodobnih i željeznodobnih gradina na istočnoj obali Jadrana još su uvijek tek donekle poznati. U svrhu proširivanja znanja o tim lokalitetima istražena je fauna srednjodalmatinskoga lokaliteta Rat kako bi se uočile promjene u načinu lova, uzgoja i obradi trupala tijekom faza života tog naselja. Kako bi se rasvijetlile te promjene, obrađen

from five occupation sequences to illuminate changes in production at this hillfort throughout the Bronze Age and Iron Age.

Key Words: Zooarchaeology, Hillfort, Bronze Age, Adriatic, Secondary Products

Introduction

The Dalmatian coastline of the eastern Adriatic is dotted by a series of impressive hillforts dating to the Bronze and Iron Ages. While the locations of these sites are well documented, few have been systematically excavated.[1] The sequence of hillfort development remains little understood in this area, still less well understood is the function of these sites in the landscape. These fortified settlements, along with associated burial mounds, appeared during Eneolithic and developed over the course of the Bronze and Iron Ages in this region.[2] From survey evidence it appears that a marked increase in the building of these sites took place around the thirteenth century BC (the local Middle Bronze Age), often strategically situated to control routes of communication and trade in the region.[3] These remained the most common type of fortified settlement until the period of Roman occupation from the 2nd/1st. century BC, when they were slowly abandoned in favour of the new urbanised centres of Roman life.

In the initial period of these two millennia (the Early Bronze Age) the area of Dalmatia formed a part of the Cetina culture area.[4] The subsequent period, the local Middle Bronze Age, is the least known from archaeological sources. Scarce evidence of trade contacts throughout the Mediterranean in the form of imported glass, amber beads and ceramics are known from Dalmatia in the Late Bronze Age. Metal artefacts from that period demonstrate contacts with the Urnfield culture of northern Croatia.[5] This period also saw the independent development of the local material culture which continued throughout the Iron Age until the Roman occupation, with intensive contacts and exchange of goods with the western Adriatic region and the Mediterranean–especially the Greek world.

It is still unknown what role these hillforts played in the settlement structure of the Bronze and Iron Age eastern Adriatic, or how their function may have changed over time. The central and defensive locations of many of these sites suggest that they may have functioned

1 Barbarić 2010a; Forenbaher, Šikanjić 2006.
2 Hammon, unpublished.
3 Barbarić 2011.
4 Della Casa 1995.
5 Barbarić 2010a.

je osteološki materijal iz brončanoga i željeznog doba kroz pet faza nalazišta.

Ključne riječi: zooarheologija, gradina, brončano doba, Jadran, sekundarni proizvodi

Uvod

Na prostoru Dalmacije nalazi se velik broj impresivnih gradina, datiranih većinom u brončano i željezno doba. Rasprostranjenost ovih naselja dobro je dokumentirana, no tek ih je nekoliko sustavno istraženo.[1] Razvojni slijed i uloga ovih naselja u prostoru relativno su slabo poznati. Gradine se na ovim prostorima pojavljuju tijekom eneolitika, kada i pokapanje pod gomilama, te se dalje razvijaju u brončano i željezno doba.[2] Rezultati terenskih pregleda pokazuju kako se krajem srednjega brončanog doba, oko 13. st. pr. Kr., dogodio porast trenda osnivanja ovakvih naselja, često strateški postavljenih radi nadziranja komunikacija.[3] Taj je oblik utvrđenog naselja ostao uobičajen sve do 2./1. st. pr. Kr. i rimske okupacije, kada su se gradine polako počele napuštati, nauštrb novih urbanih središta rimskog života.

Početkom brončanog doba Dalmacija je područje rasprostiranja cetinske kulture.[4] Sljedeće razdoblje, srednje brončano doba, najslabije je poznato iz arheoloških izvora. Iz kasnog brončanog doba postoje sporadični dokazi trgovačkih kontakata s mediteranskim svijetom, uvozne staklene i jantarne perle te ulomci uvezene lončarije. Metalni predmeti tog vremena svjedoče o kontaktima s nositeljima kulture polja sa žarama sjeverne Hrvatske.[5] Krajem tog razdoblja započeo je razvoj lokalne materijalne kulture koji se nastavio tijekom cijeloga željeznog doba, sve do vremena rimske okupacije, s intenzivnim kontaktima i razmjenom dobara sa zapadnom obalom Jadrana i Mediteranom, osobito s grčkim svijetom.

Još uvijek je nepoznata uloga pojedinih gradina i eventualne promjene njihovih uloga u naseobinskoj strukturi brončanodobnoga i željeznodobnog Jadrana. Njihov smještaj na dobro branjenim i strateški važnim položajima sugerira da su mogle služiti kao regionalna središta, pribježišta, promatračnice ili pak kao kultne građevine u prostoru. Nije poznato je li uloga ovakvih naselja ostala ista tijekom spomenutog razdoblja, premda porast njihova broja od srednjega brončanog doba nedvojbeno ukazuje na povećanu važnost takvog

1 Barbarić 2010; Forenbaher, Šikanjić 2006.
2 Hammon, neobjavljeno.
3 Barbarić 2011.
4 Della Casa 1995.
5 Barbarić 2010.

as regional centres, defensive refuges or as ritual foci in the landscape. Whether the function of these sites remained constant across the Bronze and Iron Ages or changed through time is not known, although the increase in their development during the Middle Bronze Age suggests changing or increasing importance of hillforts over the Bronze Age. To investigate changes in the development and function of these sites this paper examines the fauna from the extensive occupation sequence at the hillfort of Gradina Rat.

The settlement of Gradina Rat is located on the western part of the island of Brač, in the central Dalmatian region of the eastern Adriatic Sea. It covers a plateau of roughly five hectares along a ridge which runs above the northern boundary of the village of Ložišća. This prehistoric hillfort site was occupied from at least the Early Bronze Age until the 3rd/2nd century BC. The site occupies the plateau, including a central area or `acropolis' which can be identified by the remains of its walls.[6] The settlement overlooks the waterway to the Gate of Split as well as controlling the best access routes to the large and fertile valley further inland. From this location Gradina Rat in prehistory would have been well placed for visual control over the central Dalmatian archipelago as well as access to the prime agricultural land on the island.[7] The entire area of the site displayed a high concentration of finds from the Bronze and Iron Ages. In addition to the local ceramics were not insignificant finds (up to 4% in Iron Age layers) of sherds from vessels imported from southern Italy and the Greek world. In parts of the site there is visible evidence of a large number of storage vessels (pithos or dolio) which were probably imported from an external ceramics workshops during the Iron Age.[8]

After an initial year of survey in 2006, excavations at Gradina Rat began in 2007 as part of the `Identities and Economy of the Illyrians and Greeks in the Central Dalmatian Islands' research project of the Faculty of Philosophy in Split. Three trenches were opened along the central plateau of the site and excavated over three seasons during 2007, 2008 and 2010. An excavation at the two trenches is still not over, so the date for the initial occupation of the site is still unknown. An area of disturbed stratigraphy caused by agricultural activities was found in the first 40-50 cm of depth, causing homogenization of the majority of the remaining stratigraphy from the Iron Age at this site. Because of this we unfortunately cannot make any detailed comparisons of changes in the economy or composition of

Fig. 1. The island of Brač showing the location of Gradina Rat
Sl. 1. Otok Brač i položaj gradine Rat

oblika naselja. Kako bi se potanje istražile promjene u razvoju i ulogama gradina, ovaj rad proučava faunu iz bogatoga stratigrafskog slijeda gradine Rat.

Gradina Rat smještena je na zapadnom kraju otoka Brača (slika 1). Obuhvaća oko 5 ha prostora uzvisine koja se nalazi na grebenu sjeverno od mjesta Ložišća. To je prapovijesno naselje bilo naseljeno najkasnije krajem ranoga brončanog doba, a prema dostupnim dokazima živjelo je otprilike do 3./2. st. pr. Kr. Na lokalitetu je jasno prepoznatljiv središnji, utvrđeni dio naselja, uvjetno nazvan akropola.[6] S tog je mjesta moguć dobar pregled pomorskog prometa kroz Splitska vrata, kao i pristup najvećim poljodjelskim površinama Brača u unutrašnjosti.[7] Na cijelom je prostoru naselja visoka koncentracija površinskih nalaza iz čitavog vremena trajanja naselja. Osim lokalne lončarije, koja je najbrojnija, vrijedno je spomenuti udio od 4 % nalaza uvezenih iz južne Italije i grčkog svijeta u slojevima željeznog doba. Na pojedinim mjestima na površini vidljivi su ulomci velikih posuda (pitosa ili dolija), vjerojatno uvezenih tijekom željeznog doba.[8]

Nakon početnih terenskih pregleda 2006. iskopavanje na gradini Rat započelo je 2007. godine kao dio projekta *Identiteti i ekonomije Ilira i Grka na srednjodalmatinskom otočju* pri Filozofskom fakultetu u Splitu. Na središnjem su platou i ispod njega tijekom 2007., 2008. i 2010. istraživane tri sonde. Istraživanje dviju sondi na platou još nije završeno, tako da se još uvijek ne zna točno vrijeme početka života na lokalitetu. U stratigrafskom slijedu na platou su zamijećeni tragovi postdepozicijskih aktivnosti, intenzivnog poljodjelstva do dubine od 40-50 cm, što je dovelo do izmiješanosti željeznodobnih slojeva. Zbog toga nije bilo moguće raditi detaljne usporedbe promjena u ekonomiji na gradini Rat tijekom tog razdoblja, tako da je ukupni materijal iz željeznodobnih slojeva samo uspoređivan s detaljnije analiziranim nalazima iz brončanodobnih slojeva.

6 Barbarić 2011, p. 217.
7 Barbarić 2010b, p. 158.
8 Barbarić 2011, p. 228.

6 Barbarić 2011, str. 217.
7 Barbarić 2010b, str. 158.
8 Barbarić 2011, str. 228.

Gradina Rat over the course of the Iron Age. The entire Iron Age period is therefore compared with the more detailed analysis possible from the Bronze Age stratigraphic sequence.

With the exception of the turbated zone of Iron Age material, all layers were sieved using 5 mm mesh. A total of 6887 (13,374.4 g) faunal remains were recovered from these excavations, of which 2196 (8,582.8 g, 32.8% of remains, 64.2% of weight) were identifiable. Two radiocarbon dates were obtained from layers 7.1 (1400-1260 Cal BC) and 13 (1770-1420 Cal BC). These corresponded to the Middle and Early/Middle Bronze Age periods, respectively. The earliest material included in this analysis comes from the Early Bronze Age. This designation is given from chronological comparison of recovered material, as well as the analysis of a worked bone tool from this layer sequence (E. Cristiani, see below).

The Fauna

Faunal remains from Gradina Rat demonstrated good preservation with very little evidence of burning or carnivore/rodent gnawing of material. What evidence we do have for burning of material appears to decrease over time, with material from the Middle to Early Bronze Age demonstrating higher percentages of burned identifiable and unidentifiable fragments than later periods. The identifiable and unidentifiable element data do not show any major changes in the degree of fragmentation of remains over time. These data indicate that no period from this site was subject to a far greater level of fragmentation, burning or other destruction of material than the others. The representation of elements from each taxon also indicates that the material from Rat has not been biased from density-mediated attrition, as denser and less dense elements are equally well represented (see Sanford 2010; 2012).[9]

Identifiable material from Gradina Rat was sorted by element and taxon. Those remains which could not be securely identified to taxon (rib, vertebra and cranial fragments, as well as long bone shafts) were coded according to size class of animal. These size classes are numbered one to five with size one denoting animals smaller than a rabbit, size two animals between rabbit and small carnivores in size, size three animals of ovicaprid or small cervid size, size four red deer or pig-size animals and size five horse and bovid-sized animals. For each layer the NISP (Number of Identified Specimens) and MNI (Minimum Number of

9 Ioannidou 2003; Lyman 1994; Symmons 2005.

S iznimkom izmiješanoga željeznodobnog horizonta svi su slojevi prosijavani kroz sito otvora 5 x 5 mm. Ukupno je pronađeno 6887 (13.374,4 g) kostiju i ulomaka kostiju, od čega je 2196 (8.582,8 g, 32,8 % ukupnog broja, 64,2 % ukupne težine) bilo prepoznatljivo. Dva radiokarbonska datuma dobivena su iz slojeva 7.1 (1400-1260 Cal BC) i 13 (1770-1420 Cal BC). Oni odgovaraju vremenu prijelaza iz ranoga u srednje brončano doba te srednjem brončanom dobu. Najraniji materijal koji je uključen u analizu potječe iz slojeva ranoga brončanog doba. Ta je datacija načinjena na osnovi usporedbe arheoloških nalaza iz slojeva, ali i analize koštanog alata iz tih slojeva (vidi dalje, E. Christiani).

Fauna

Životinjske kosti s gradine Rat dobro su očuvane, s vrlo malo dokaza o djelovanju vatre, glodavaca ili mesojeda. Tragovi izlaganja vatri opadaju s trajanjem naselja, s većim udjelom takvog materijala u slojevima ranoga i srednjega brončanog doba u odnosu na željeznodobne slojeve. Prepoznatljivi i neprepoznatljivi materijal ne pokazuje velike promjene u postotku usitnjenosti kroz vrijeme. Ovi podaci pokazuju kako materijal ni u jednom razdoblju nije bio izložen većem stupnju usitnjavanja, gorenju ili kakvom drugom uništavanju. Na osnovi podataka o zastupljenosti anatomskih elemenata prema pojedinim taksonomskim kategorijama, razvidno je da su podjednako zastupljeni elementi veće i manje gustoće koštanog tkiva, što pokazuje kako propadanje uvjetovano gustoćom tkiva nije utjecalo na zastupljenost materijala s Rata (vidi: Sanford 2009; 2012).[9]

Prepoznatljivi materijal s Rata razvrstan je prema koštanom elementu i vrsti. Oni ostaci koji se nisu mogli taksonomski odrediti (fragmenti rebara, kralješaka i lubanja, kao i dugih kostiju), razvrstani su prema kategorijama veličine životinja. Te su kategorije numerirane od 1 do 5, pri čemu kategorija 1 predstavlja životinje manje od zeca, kategorija 2 životinje veličine između zeca i manjih mesojeda, kategorija 3 životinje veličine malih preživača (*Capra*/*Ovis*) ili manjeg cervida, kategorija 4 veličine običnog jelena ili svinje te kategorija 5 životinje veličine konja ili goveda. Za svaki sloj je NISP (broj identificiranih uzoraka) i MNI (minimalni broj jedinki) izračunan kako to predlaže Lyman,[10] s uzimanjem u obzir velikih otklona u kategoriji dobi (tj. mladih i odraslih jedinki).

9 Ioannidou 2003; Lyman 1994; Symmons 2005.
10 Lyman 2008.

Unidentifiable						
Period	*Number of Fragments*	*Fragments Weight (g)*	*% Total (%g)*	*Number Bruned (%)*	*WeightBurned (%)*	*Average Weight (g)*
Iron Age	337	621.1	57.0 (33.5)	10 (3.0)	25.2 (4.1)	1.8g
Late Bronze Age	1513	1658.0	65.5 (29.1)	36 (2.4)	40.3 (2.4)	1.1g
Middle Bronze Age	654	827.0	71.9 (40.2)	62 (9.5)	87.3 (10.6)	1.3g
Early/Middle Bronze Age	1181	1109.4	75.9 (39.5)	63 (5.3)	70.9 (6.4)	0.9g
Early Bronze Age	870	727.1	66.4 (34.6)	105 (12.1)	71.7 (9.9)	0.8g
Identifiable						
Period	*NISP (g)*	*Weight of NISP (g)*	*% Total (%g)*	*% Burned NISP*	*% Gnawed NSIP*	*Average Weight (g)*
Iron Age	254	1233.7	43.0(66.5)	0.0%	0.4%	4.9g
Late Bronze Age	826	3950.7	34.5(70.9)	0.5%	0.6%	4.8g
Middle Bronze Age	255	1228.6	28.1(59.8)	5.9%	*0.4%	4.8g
Early/Middle Bronze Age	376	1698.9	24.1(60.5)	7.7%	*1.1%	4.5g
Early Bronze Age	440	1373.6	33.6(65.4)	2.3%	0.2%, *0.3%	3.1g

Table 1. Summary data for unidentifiable and identifiable remains at Rat. Remains considered 'unidentifiable' consisted of those small bone fragments, under 5 cm in size, which contained no diagnostic facets or surfaces. Asterisks (*) denote percentages of rodent gnawing.
Tablica 1. Ukupni podaci za prepoznatljive i neprepoznatljive ostatke s Rata. Neprepoznatljivi ostaci sastojali su se od manjih fragmenata kostiju, veličine ispod 5 cm, bez dijagnostičkih rubova ili površina. Zvjezdica (*) označava postotke ostataka koje su oštetili glodavci.

Individuals) were calculated as described by Lyman,[10] including the consideration of greatly differing age classes (i.e. infant and adult remains).

Butchery

The process of carcass dismemberment and marrow extraction remains the same across all periods of occupation for Rat. The animal was first skinned, as can be seen by skinning marks on the first phalanges and metapodials of sheep, goats and cattle. The cranium was in many cases chopped through,[11] presumably either as part of the removal of the head or in order to extract the brain.[12] Horn cores were in some cases also removed by chopping. In rare cases vertebrae have been chopped through, which suggests that the division of the carcass along the axis (spine and pelvis) was not a common feature of butchery. Those cases of obviously chopped (laterally bisected, not broken) vertebrae were found in Iron Age contexts only.

Mesarenje

Način komadanja trupla i izvlačenja koštane srži ostao je isti tijekom svih razdoblja na Ratu. Životinja bi najprije bila oderana, što se vidi prema tragovima na prvim člancima prstiju i metapodijima ovaca, koza i goveda. Lubanja je u mnogo slučajeva bila rascijepljena,[11] vjerojatno ili postupkom odvajanja glave ili prilikom vađenja mozga.[12] Rožišta rogova u nekim su slučajevima također odcijepljena. U manjem su broju slučajeva kralješci rascijepljeni, što ukazuje da uzdužno rascijepanje trupa (kroz kralješnicu i zdjelicu) nije bio uobičajen mesarski postupak. Svi primjeri očito rascijepljenih, a ne prelomljenih kralješaka pronađeni su u željeznodobnom kontekstu.

Tragovi cijepanja, poput onih na lubanji, korijenu rogova i kralješcima, uobičajeniji su u slojevima kasnoga brončanog i željeznoga doba, što pokazuje ili promjenu u načinu mesarenja ili pak uvođenje težih, željeznih alata u mesarenju. Teži noževi mnogo su bolji za tehniku cijepanja trupla i ostavljaju mnogo uočljivije tragove negoli se to događa kod postupka

10 Lyman 2008.
11 The general term `chopped through' in this paper refers to the lateral bisection of the bone with either a single blow or a series of blows. In the Rat material this form of butchery was most often implemented using a heavy blade.
12 Seetah 2006, p. 20.

11 U slučaju lubanje termin *rascijepljen* u ovom se radu odnosi na bočno raspolavljanje jednim udarcem ili s nekoliko udaraca. Na materijalu s Rata ovaj se postupak najčešće izvodio težim nožem.
12 Seetah 2006, str. 20.

Chop marks, such as those on the cranium, horn cores and vertebrae, are more commonly found in the Late Bronze and Iron Age contexts, suggesting either a change in the butchery patterns or the introduction of heavy iron tools for butchery purposes. Heavier knives would be more suited to the `chopped' dismemberment of a carcass, and leave more distinct traces than dismemberment through filleting/defleshing alone.[13] Additional processing of carcasses can be seen in all periods in the presence of cut marks (thin fine cuts, often in multiple parallel rows) around the knee joint (distal femur and proximal tibia), ankle joint (distal tibia and proximal metatarsal) and around the junction of the radius, humerus and ulna. These marks suggest that after skinning, ligaments and tendons were severed at joints to separate the bones.

The main evidence for butchery from Rat comes not in the form of cut marks but in the breakage and splitting of bones, presumably to extract marrow. During analysis a note was made for each bone with evidence of fresh or `green' fractures (those fracture patterns indicating breakage of freshand un-cooked as opposed to old and dry bone).[14] In all layers roughly one-third of major limb elements (humerus, radius, femur, tibia and metapodia) showed clear fresh fractures. The remaining two-thirds had either been broken dry or had received additional breaks which overlay the fresh fractures.

For each major limb bone these fresh fractures were located close to the proximal or distal ends of elements. In addition, radii, tibiae and metapodials showed evidence of having been split for their marrow. This was sometimes coupled with the occurrence of fresh fractures at metaphyses, although such splitting was normally the only sign of butchery on the element. It should be noted that phalanges, pelvic bones and other elements with small marrow deposits did not show fresh fractures or splitting. This suggests that the inhabitants of Rat did not habitually experience nutritional stress causing them to intensively exploit marrow sources from slaughtered animals.[15] With the exception of the possible introduction of heavy butchery tools in the Late Bronze and Iron Ages, these butchery data do not suggest significant changes in the habitual process of carcass dismemberment and consumption at Gradina Rat over the periods studied.

filetiranja i odvajanja mesa s kosti.[13] Daljnja obrada trupla vidi se u svim razdobljima u prisutnosti tragova rezanja (fini tanki rezovi, često u višestrukim usporednim redovima) na kostima koljenog zgloba (distalni okrajak femura i proksimalni okrajak tibije), skočnog zgloba (distalni okrajak tibije i proksimalni okrajak metatarzalne kosti) i na spoju radijusa, humerusa i ulne. Ovi tragovi pokazuju da su nakon skidanja kože prerezani ligamenti i tetive zglobova kako bi se odvojile kosti.

Glavni dokaz mesarenja s Rata ipak nisu urezi na kostima, već lomljenje i raspolavljanje kostiju, vjerojatno zbog izvlačenja koštane srži. Prilikom obrade posebno su zabilježene sve kosti s tragovima svježih lomova (lomovi nastali na svježoj kosti prije pripravljanja za jelo, nasuprot onih napravljenih na staroj i suhoj kosti).[14] U svim slojevima otprilike trećina većih kostiju udova (humerus, radijus, femur, tibija i metapodijalne kosti) pokazuje svježe lomove. Druge dvije trećine su ili lomljene suhe ili su dodatno lomljene, čime su preslojeni raniji, svježi lomovi.

Kod svake veće kosti udova ove su svježe frakture načinjene u blizini proksimalnih ili distalnih okrajaka. Nadalje, radijusi, tibije i metapodijalne kosti pokazuju tragove uzdužnih lomova zbog vađenja koštane srži. To se ponekad preklapa s postojanjem svježih lomova na metafizama, iako je zapravo takvo raspolavljanje uglavnom jedini trag mesarenja na tom elementu. Mora se primijetiti kako na člancima prstiju, zdjeličnim kostima i drugim elementima s malom količinom koštane srži nisu pronađene ranije, svježe frakture ili tragovi raspolavljanja. To pokazuje kako stanovnici Rata uglavnom nisu bili izloženi nestašicama hrane koje bi ih natjerale na detaljnije izvlačenje koštane srži.[15] S izuzetkom mogućeg uvođenja težih mesarskih alata u vremenu kasnoga brončanoga i željeznoga doba, tragovi mesarenja ne pokazuju veće promjene ustaljenog procesa komadanja trupala i konzumacije mesa na gradini Rat tijekom istraženog razdoblja.

Lov na Braču: divlje vrste s Rata

Najuobičajenija divlja vrsta na Ratu je obični jelen (*Cervus elaphus*) i srna (*Capreolus capreolus*). Ove vrste su u manjem broju prisutne u svim slojevima na Ratu, pa pretpostavljamo da su predstavljale manji, ali stabilan udio u prehrani stanovnika ovog naselja tijekom duljega razdoblja. Sljedeća vrsta koja se nalazi na Ratu je zec (*Lepus europaeus*), kojeg uopće ne nalazimo u slojevima željeznoga i kasnoga brončanoga

13 Seetah 2006, p. 197.
14 Karr, Outram 2012a, 2012b; Lyman 1994, p. 324.
15 Mateos 2006; Outram 2006.

13 Seetah 2006, str. 197.
14 Karr and Outram 2012a, 2012b; Lyman 1994, str. 324.
15 Mateos 2006; Outram 2006.

Hunting on Brač: the wild taxa of Rat

The most common wild taxa present at Rat are red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*). These taxa are found at low levels from all periods at Rat, suggesting that they formed a stable and at least minor contribution to the diet of the inhabitants at this settlement over several centuries. The next most commonly found taxon is the hare (*Lepus europaeus*), which is completely absent from the Iron and Late Bronze Age layers but found at low levels in the Middle to Early Bronze Age contexts. Hare remains from these contexts demonstrate evidence of butchery in the form of cutmarks (defleshing rather than skinning marks), and therefore can be determined to have contributed to the diet at Rat. A single scapula of a younger adult beaver (*Castor fiber*) was recovered from Late Bronze Age, suggesting its use (however infrequent) as a food or fur animal. A single humerus of a wild cat (*Felis sylvestris*) was recovered from Middle Bronze Age contexts of Rat. Neither of these elements (scapula or humerus) bore any cut marks or other obvious traces of butchery, so it is impossible to determine their status in the assemblage (as food, fur or naturally present animals). Given the presence of these shy, non-commensal animals within domestic contexts of Gradina Rat it is presumed that their presence is the result of procurement by the site's occupants.

From the low representation of remains from wild taxa, hunting appears to have been an infrequent activity at Gradina Rat–although one whose occurrence remained fairly consistent throughout the occupation sequence with only a slight decrease during the Middle Bronze Age. It is not possible to determine if hunting at Rat was a seasonal activity, as remains of wild taxa were not numerous and in the majority come from adult animals. A single unerupted deciduous upper third premolar from a red deer was found in Early/Middle Bronze Age contexts, and a single unfused distal tibia and two juvenile astragali from the same taxon were found in Late Bronze Age contexts. For roe deer the only finds of immature animals come from an unerupted mandibular second molar from the Iron Age contexts, an unfused acetabular illium from Late Bronze Age contexts and unfused proximal femur from Middle Bronze Age contexts. These few finds of immature animals suggest that, although the majority of deer hunted at Rat were adults this was not always the case. All recovered hare bones, as well as those finds of cat, come from adult animals.

Domesticates

The remains of domesticated animals form the dominant component of the sample for each period doba, već je prisutan u donjim slojevima srednjega i ranoga brončanog doba. Zečje kosti iz tih slojeva pokazuju dokaze mesarenja u obliku ureza (nastalih vjerojatno skidanjem mesa s kosti prije negoli deranjem), pa se može reći da su korišteni u prehrani na Ratu. Iz sloja kasnog brončanog doba potječe jedna lopatica mlađe odrasle jedinke europskog dabra (*Castor fiber*), pa je moguće da se ta vrsta rijetko koristila kao izvor hrane ili krzna. Jedan humerus divlje mačke (*Felis sylvestris*) pronađen je u slojevima srednjega brončanog doba na Ratu. Nijedan od ovih dvaju elemenata (lopatica i humerus) nema nikakvih ureza ili drugih tragova mesarenja, pa je nemoguće reći jesu li životinje donesene na lokalitet kao hrana ili samo zbog njihova krzna. S obzirom na plašljivu i nepripitomljivu prirodu ovih vrsta, njihova je prisutnost na lokalitetu najvjerojatnije rezultat dobavljanja od strane njegovih stanovnika.

Sudeći prema niskom udjelu kostiju divljih životinja lov nije bio česta aktivnost na Ratu, iako se može reći da je zadržao isti intenzitet u većem dijelu razdoblja života naselja, s manjim padom tijekom srednjega brončanog doba. Nije moguće utvrditi je li lov na Ratu bio tek sezonska aktivnost jer ostaci divljih životinja nisu brojni i većinom potječu od odraslih jedinki. Jedan mliječni gornji treći pretkutnjak običnog jelena koji nije probio iz čeljusti pronađen je u rano/srednjobrončanodobnim slojevima. U slojevima kasnoga brončanog doba nađeni su jedan nesrasli distalni okrajak tibije i dva talusa juvenilnih običnih jelena. Jedini nalazi juvenilnih jedinki srne jesu mandibularni drugi kutnjak koji nije probio iz čeljusti iz slojeva željeznog doba, nesrasli acetabularni dio ilijuma iz kasnobrončanodobnog sloja i nesrasli proksimalni dio femura iz srednjega brončanog doba. Sve pronađene kosti zeca i mačke pripadaju odraslim jedinkama.

Domaće životinje

Ostaci domaćih životinja čine najveći udio uzorka iz svih razdoblja, i to od 90-94 % NISP po razdoblju. Najčešće domaće životinje su ovce (*Ovis aries*) i koze (*Capra hircus*), s prosjekom od ukupno 80 % NISP za sva razdoblja. Omjer ovaca i koza (prema NISP) je 4:3 u željezno doba, 73:37 (otprilike 2:1) u kasno brončano doba, 8:1 u srednje brončano doba, 3:2 za rano/srednjobrončano doba i 47:14 (otprilike 3:1) za rano brončano doba.

Sljedeća najčešće zastupljena vrsta domaćih životinja na Ratu je svinja (*Sus domesticus*), prisutna u udjelu od 8 % u ukupnom skupu nalaza. Slijedi govedo (*Bos taurus*), s udjelom od 4,6 % u ukupnom skupu nalaza. Kad se usporede MNI (minimalni broj jedinki) goveda i svinja, ravnomjernije su raspoređeni unutar ukupnog skupa nalaza, pa je možda veći broj

studied, comprising 90-94% of NISP by period. The most common domesticates in these periods are by far sheep (*Ovis aries*) and goats (*Capra hircus*), averaging roughly 80% of NISP for all periods. The ratio (from NISP) of sheep to goats is 4:3 for the Iron Age, 75:37 (or nearly 2:1) for the Late Bronze Age, 8:1 for the Middle Bronze Age, 3:2 for the Early/Middle Bronze Age and 47:14 (or roughly 3:1) for the Early Bronze Age.

The next most commonly represented taxon at Rat is the pig (*Sus domesticus*), present at an average of 8% across all periods. These are followed by cattle (*Bos taurus*) at an average of 4.6% across all periods. When the MNI is compared between cattle and pigs they are more evenly represented across the excavated periods, so it is possible that this increased representation of *Sus* is an artefact of fragmentation. Size four remains (pig sized) are more common in all periods than those of size five (cattle sized), which suggests that this might be the case. From the present sample, remains of *Sus* appear to decrease over time from the Early to Late Bronze Age, although this decrease is by no means consistent. Remains of *Bos* show an increase from the Early to Early/Middle Bronze Age and then a steady decrease to the Iron Age.

The final domesticate present at Rat is the dog (*Canis familiaris*). Dogs are present at Rat in all periods save for the Middle Bronze Age, although are more common in the Late Bronze and Iron Ages. This suggests that, while dogs were kept at Rat in all periods represented, they may have been more commonly found or at least deposited on the site in later periods. Dog bones from Rat demonstrate no cut marks or other signs of butchery aside from a single `fresh' break to a proximal femur from Late Bronze Age contexts.

Animal Management at Gradina Rat

Taxonomic distributions of wild and domestic animals at Gradina Rat do not demonstrate distinct changes during the periods of occupation. The Middle Bronze Age is a possible exception to this, with the greatest emphasis on sheep (based upon both NISP and MNI representation) and the least representation of hunted taxa of periods considered. In order to determine if patterns in livestock management were likewise similar at Rat over the periods of occupation, culling profiles were compiled for each taxon. The distribution of remains by age class can be seen in Table 2 and Fig. 2. As the majority of teeth recovered from Rat were individual teeth (e.g. not entire jaws), teeth were aged through the Quadratic Crown Height Method (QCHM).[16]

16 As described by Klein, Allwarden, Wolf 1983.

kostiju svinje posljedica fragmentacije. Ostaci veličine 4 (veličina svinje) uobičajeniji su za sva razdoblja u odnosu na one veličine 5 (veličina goveda), što svjedoči da navedena tvrdnja vjerojatna. Iz postojećeg uzorka udio ostataka svinje opada s vremenom od ranog do kasnog brončanog doba, iako taj trend nije konstantan. Udio ostataka goveda povećava se unutar uzorka od ranog brončanog doba prema ranom/srednjem brončanom dobu i dalje se postupno smanjuje prema željeznom dobu.

Zadnja domesticirana životinja prisutna na Ratu je pas (*Canis familiaris*). Psi su prisutni na Ratu u svim slojevima osim u srednjem brončanom dobu. Iako je NISP veći u kasno brončano i željezno doba, MNI je jednak za sva razdoblja. To ukazuje da su se psi držali na Ratu uglavnom u svim razdobljima, ali da su se možda češće pokopavali na lokalitetu u kasnijim razdobljima. Kosti pasa s Rata ne pokazuju tragove mesarenja osim jednog 'ranog' loma proksimalnog femura iz slojeva kasnoga brončanog doba.

Stočarstvo na gradini Rat

Distribucija domaćih i divljih vrsta životinja na gradini Rat ne pokazuje značajne promjene tijekom različitih razdoblja naseljenosti. Srednje brončano doba možda je iznimka, s naglaskom na ovce (prema pokazateljima NISP i MNI) i najmanjim udjelom lovnih vrsta od svih faza nalazišta. Kako bi se odredilo jesu li načini upravljanja stokom na Ratu bili slični u svim razdobljima, uzorci selekcije sastavljeni su za sve vrste. Distribucija ostataka prema dobi predstavljena je u tablici 2. i na slici 2. Kako većina zubi pronađenih na Ratu spada u pojedinačne nalaze (tj. bez očuvanih čeljusti), dob je određena prema *Quadratic Crown Height Method* (QCHM).[16]

Uzorci selekcije sastavljeni su samo za vrste *Ovis*, *Capra* i *Sus*. Ostaci vrste *Bos* nisu dovoljno brojni da bi se izračunali dobni profili ni kada se kombiniraju sva razdoblja, a gotovo svi zubi kojima se može odrediti dob potječu od odraslih jedinki. Iznimke su jedan treći mandibularni pretkutnjak u stadiju izbijanja (rano brončano doba) i neizrasli mandibularni treći pretkutnjak (kasno brončano doba), koji pripadaju jedinkama dobi 24 do 30 mjeseci. Ti oskudni podaci, zajedno s boljim podacima o srastanju epifiza dugih kostiju, pokazuju da je većina goveda zaklana u odrasloj dobi. Ovakvo prevladavanje odraslih jedinki ukazuje na gospodarenje usmjereno proizvodnji sekundarnih proizvoda poput mlijeka, vuče ili prestiža.[17]

16 Onako kako to predlažu Klein, Allwarden, Wolf 1983.
17 Russell 2012, str. 307.

Taxon	Iron Age		Late Bronze Age		Middle Bronze Age		Early/Middle Bronze Age		Early Bronze Age	
	NISP(%)	*MNI*	*NISP(%)*	*MNI*	*NISP(%)*	*MNI*	*NISP(%)*	*MNI*	*NISP(%)*	*MNI*
Bos	2(1.6)	1	22(4.8)	2	7(5.4)	1	11(6.6)	2	6(3.3)	1
Sus	5(4.1)	1	35(7.7)	2	5(3.9)	1	7(4.2)	1	32(17.6)	2
Ovis/Capra	104(85.2)	6	357(78.5)	9	109(84.5)	9	135(81.3)	7	126(69.2)	6
[*Ovis*]	[12]	[2]	[75]	[6]	[8]	[3]	[6]	[2]	[47]	[3]
[*Capra*]	[9]	[2]	[37]	[2]	[1]	[1]	[4]	[1]	[14]	[3]
Canis	2(1.6)	1	8(1.8)	1			1(0.6)	1	1(0.5)	1
Cervus	8(6.6)	2	13(2.9)	1	1(0.8)	1	5(3.0)	1	1(0.5)	1
Capreolus	1(0.8)	1	11(2.4)	2	2(1.6)	1	5(3.0)	2	8(4.4)	1
Lepus					1(0.8)	1	1(0.6)	1	6(3.3)	1
Felis					1(0.8)	1				
Castor			1(0.2)	1						
Fish			8(1.8)	1	3(2.3)	1	1(0.6)	1	2(1.1)	1
Total	**122**	**12**	**455**	**19**	**129**	**16**	**166**	**16**	**182**	**14**
Size 1					1	1	1	1		
Size 2	3	1	29	1	14	1	20	1	42	1
Size 3	107	4	306	8	105	3	160	4	194	4
Size 4	18	1	17	1	5	1	11	1	8	1
Size 5	3	1	10	1	1	1	3	1	11	1
Total	**131**		**362**		**125**		**195**		**255**	
Aves	1	1	9	1	1	1	14	2	3	1
NISP	**254**		**826**		**255**		**376**		**440**	

Period	Infant NISP (%)	Juvenile NISP (%)	Sub-Adult NISP (%)	Adult NISP(%)
Ovisaries				
Iron Age	4 (8.9)	3 (6.7)	8 (17.7)	30 (66.7)
Late Bronze Age	32 (23.2)	19 (13.8)	37 (26.8)	50 (36.2)
Middle Bronze Age	4 (10.8)	3 (8.1)	8 (21.6)	22 (59.5)
Early/Middle Bronze Age	4 (5.9)	23 (33.8)	18 (26.5)	23 (33.8)
Early Bronze Age	5 (17.9)	9 (32.1)	6 (21.4)	8 (28.6)
Capra hircus				
All Periods		2 (3.8)	14 (26.4)	37 (69.8)
BosTaurus				
All Periods	1 (2.3)	2 (4.7)	5 (11.6)	35 (81.4)
Sus domesticus				
All Periods		3 (12.0)	17 (68.0)	5 (20.0)

Table 2. Taxonomic distributions and epiphyseal fusion age groups for the fauna of Gradina Rat. Taxa are quantified by period according to both NISP and MNI, with a separate consideration for those elements identifiable only to size class. NISP values are given for Ovis/Capra, with the contributing values of ***Ovis aries*** *and* ***Capra hircus*** *to this overall value shown in brackets [].*
Tablica 2. Taksonomska distribucija i dobne skupine prema podacima o sraštavanju epifiza na fauni s gradine Rat. Vrste su razvrstane i kvantificirane po razdobljima prema vrijednostima NISP i MNI, a uzorci odredivi tek po veličini odvojeno su prikazani. NISP vrijednosti su date za Ovis/Capra, a udjeli ***Ovis aries*** *i* ***Capra hircus*** *dati su u zgradama [].*

Culling profiles were compiled only for *Ovis*, *Capra* and *Sus*. *Bos* remains were not numerous enough to construct an age profile even when all periods were combined, and all ageable teeth came from adult individuals with the exception of a single erupting mandibular third molar (Early Bronze Age) and a deciduous mandibular third premolar (Late Bronze Age), both

Dobno odredivi ostaci koza, kao i goveda, nisu bili brojni. Usprkos tome, moguće je sastaviti pretpostavljeni uzorak za dob klanja kada se usporede svi horizonti lokaliteta. Ukupno se može reći kako su koze na Ratu većinom klane kao odrasle ili gotovo odrasle jedinke, dakle zbog mesa. Nekoliko dobno odredivih ostataka svinja ukazuje na dominirajuću prisutnost

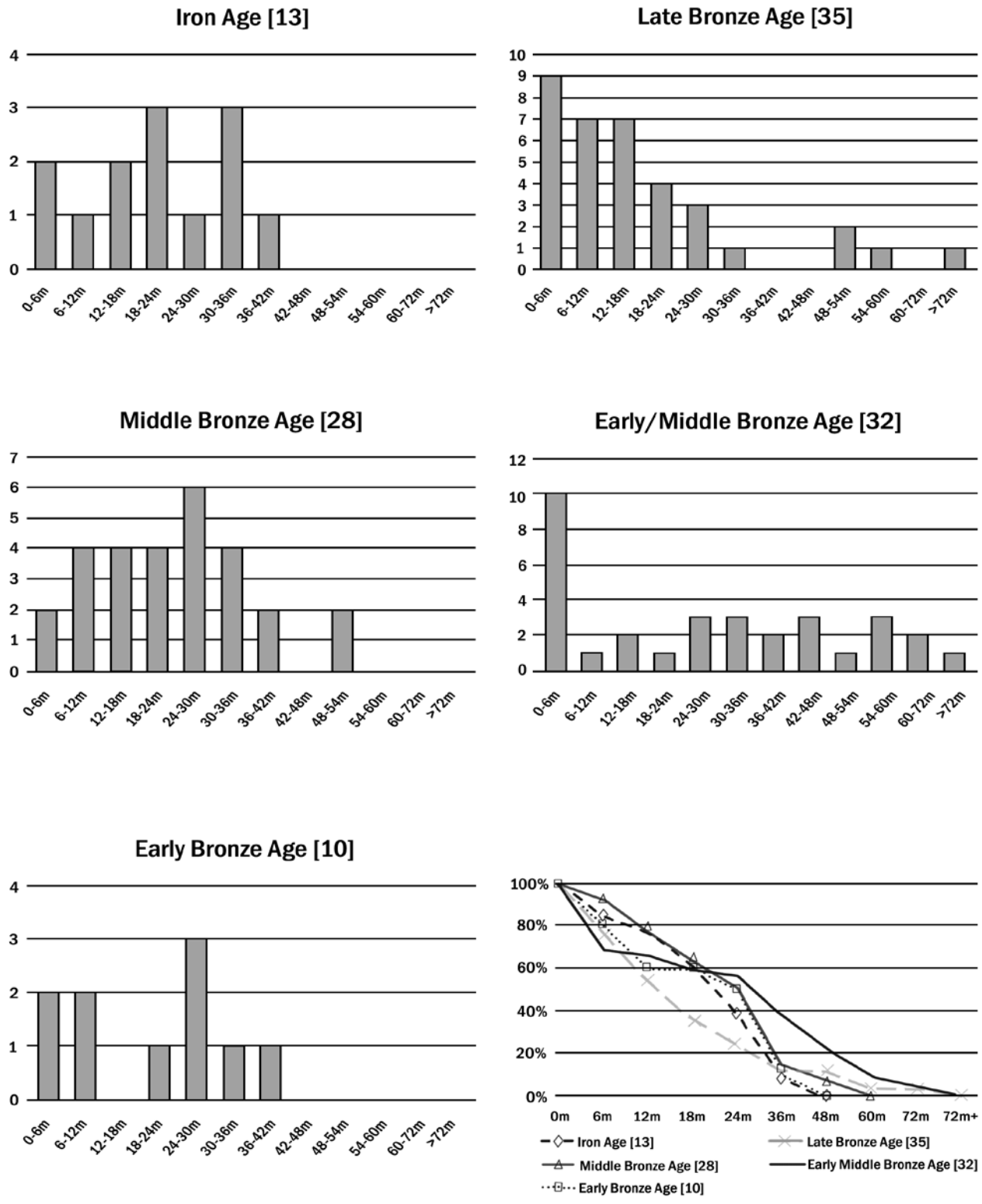

Fig. 2. Age distribution of sheep (Ovis aries) at Rat on the basis of tooth wear (QCHM). The number of measured teeth for each period is given in brackets. Histograms A through E detail the age distribution of crown heights by period. Cumulative survivorship (age-at-death) curves constructed from these values are given in Table F.
Sl. 2. Dobne skupine ovaca (Ovis aries) s Rata određene prema istrošenosti zubi (QCHM). Broj uzoraka zubi za svako razdoblje dan je u zagradama. Histogramima A-E detaljnije su prikazane visine kruna prema razdobljima. Graf F izrađen je prema tim vrijednostima i prikazuje doživljenu dob.

from individuals aged 24-30 months. These meagre data, combined with the more numerous data from epiphyseal fusion, suggest that the majority of cattle were slaughtered as adults. This curation of adult animals suggests management aimed at the production of secondary products such as milk, traction or prestige.[17]

Ageable goat remains, as with cattle, were not numerous. However, it is still possible to compile a tentative pattern for their ages of slaughter when all occupation periods are combined. On the whole we can see that goats at Rat were in the majority slaughtered as adults or as sub-adults, suggesting a management primarily for meat. The few ageable remains of pigs indicate a general slaughter pattern at this site of predominately immature animals. A particular emphasis can be seen on the slaughter of pigs between six to twelve months and two years of age. Pigs do not produce secondary products, and so would have been kept at Rat only for their meat. A few animals survived into adulthood (in this case, more than four years of age), but they are very much in the minority.

The most detailed age profile information was available for sheep, due to the proportional dominance of this taxon. The distribution of ageable remains can be seen in Table 2 and Fig. 2. From these data it is clear that management practices for sheep varied greatly during the Bronze Age. No period at Rat shows specialized production for secondary products such as described by Payne.[18] This is however not unexpected, as the idealized culling profiles given by Payne relate to modern specialized production. The general pattern suggests that sheep were utilized at Rat for both meat (primary) as well as secondary products; although this exploitation varied over time. The slaughter profiles compiled for the Early and Early/Middle Bronze Ages contain a dominance of infantile and adult animals, suggesting a focus on use of these animals for meat and milk. From the Middle Bronze Age we can see a distinct alteration in the age-at-death profiles for sheep, with a reversal from consumption primarily of very young and adult animals to one which focuses on subadult and adult animals. This slaughter profile changes again in the Late Bronze Age to incorporate in a high proportion of infant and juvenile sheep which is not seen in the subsequent Iron Age.

Biometric Comparisons

The observed changes in age-at-death for sheep at Rat over the Bronze Age suggested changes in the management of these animals for secondary products.

nezrelih jedinki generalno na cijelom lokalitetu. Naglasak je pri tome na klanju svinja u dobi između 6 i 12 mjeseci i 2 godine. Od svinja nema sekundarnih proizvoda, pa su stoga na Ratu držane zbog mesa. Rijetke su preživjele do odrasle dobi (u jednom slučaju do više od četiri godine), ali tu se radi o izrazitim iznimkama.

Najdetaljniji profil dobi jedinki bio je dostupan za ovce, s obzirom na dominantan udio ove vrste u ukupnim nalazima. Raspoređenost dobno odredivih ostatka vidi se na tablici 2. i slici 2. Iz ovih podataka jasno je da je gospodarenje ovcama prilično variralo tijekom brončanog doba. Nijedno razdoblje na Ratu ne pokazuje specijaliziranu sekundarnu proizvodnju kako to opisuje Payne.[18] To nije neočekivano jer se idealni profili selekcije koje donosi Payne odnose na modernu specijaliziranu proizvodnju. Generalni uzorak pokazuje da su ovce na Ratu korištene i za meso i za sekundarne proizvode, ali je omjer varirao kroz vrijeme. Uzorak klanja sastavljen za rano i rano/srednje brončano doba sadrži dominantan broj nezrelih i odraslih jedinki i ukazuje na korištenje životinja za meso i mlijeko. Od srednjeg brončanog doba razvidne su promjene u dobi zaklanih ovaca, od spomenutog korištenja veoma mladih i odraslih jedinki prema uzorku koji je koncentriran na odrasle i gotovo odrasle životinje. Taj uzorak klanja ponovno se mijenja u kasno brončano doba, kako bi uključio visoki udio nezrelih i mladih jedinki što se ne nastavlja u željezno doba.

Biometrijske usporedbe

Zapažene promjene u dobi pri klanju ovaca s Rata tijekom brončanog doba pokazuju promjene u gospodarenju ovim životinjama i njihovom korištenju za sekundarne proizvode. Visoki udio nezrelih i mladih jedinki (ispod šest mjeseci) u rano i kasno brončano doba pokazuje gospodarenje usmjereno povećanoj proizvodnji mlijeka. Zadržavanje većine životinja starijih od ove dobi u srednje brončano doba i u kasnijim razdobljima pokazuje da je gospodarenje ovcama usmjereno na meso i vunu. Gospodarenje u svrhu proizvodnje vune uključuje zadržavanje odraslih ovnova, dok proizvodnja mlijeka i mesa uglavnom uključuje klanje viška mužjaka kao nezrelih i mladih jedinki.[19] Zbog toga su proučeni biometrijski podaci za domaće životinje na Ratu, kako bi se utvrdile promjene u omjerima spolova u stadima tijekom brončanog i željeznog doba. Mjerenje potpuno sraslih elemenata obavljeno je do preciznosti od desetine

17 Russell 2012, p. 307.
18 Payne 1973.

18 Payne 1973.
19 Halstead 1996, str. 25; Halstead 1999, str. 150.

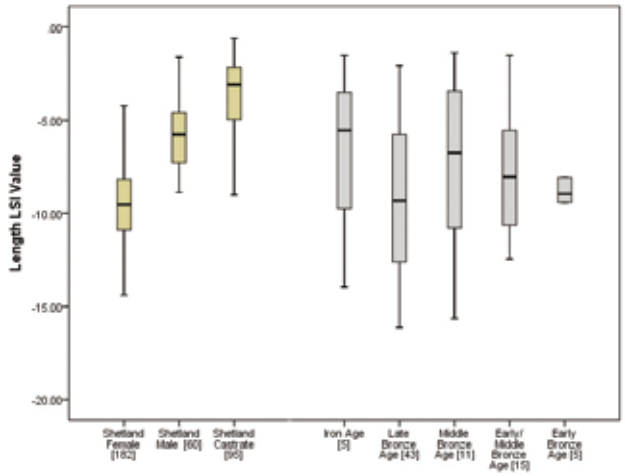

Fig. 3. Comparison of LSI values of length (Gl) for bones of Ovis aries from Gradina Rat, as compared with the range of sexual and population variation of a group of Shetland sheep sampled by Davis (1996; 2000)
Sl. 3. Usporedba LSI vrijednosti duljine (Gl) kostiju Ovis aries s gradine Rat i spolnih te populacijskih varijacija uzorka šetlandskih ovaca prema Davis (1996; 2000)

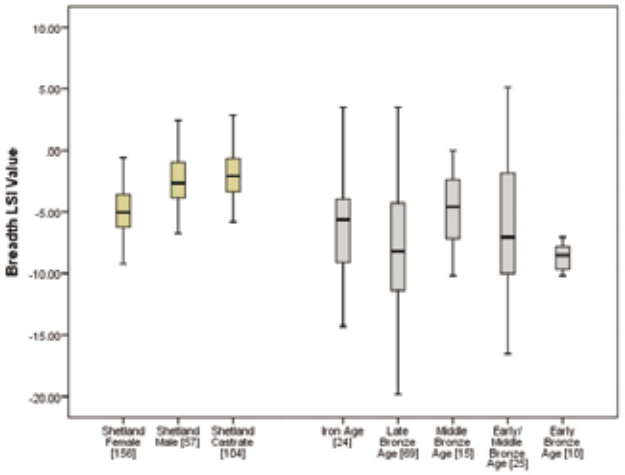

Fig. 4. Comparison of LSI values of breadth (Bp or Bd) for bones of Ovis aries from Gradina Rat, as compared with the range of sexual and population variation of a group of Shetland sheep sampled by Davis (1996; 2000)
Sl. 4. Usporedba LSI vrijednosti širine (Bp ili Bd) kostiju Ovis aries s gradine Rat i spolnih te populacijskih varijacija uzorka šetlandskih ovaca prema Davis (1996; 2000)

The high levels of infant and juvenile animals (under six months of age) in the earlier and Late Bronze Age indicates management geared towards an increased production of milk. The retention of the majority of animals beyond this point in the Middle Bronze Age and later periods suggests an added focus on meat or wool in sheep management practices. Wool management practices also often include the retention of adult males; whereas meat and milk production strategies generally involve the slaughter of excess males while juveniles or sub-adults.[19] For this reason, biometric data was examined for domesticates at Rat to identify changes in the sex proportions of herds over the Bronze and Iron Ages. Measurements of fully-fused elements were taken to the nearest tenth-millimetre following the criteria laid out by von den Driesch.[20]

Changes in the sexual composition of sheep herds is best identified biometrically through comparisons of bone length and breadth. From studies by Davis[21] on modern Shetland sheep we can see that sexual variation is more strongly expressed in bone length than breadth, particularly for castrates. Bone measurements for sheep (*Ovis aries*) were translated into Log Standard Index (LSI) values following the equation *Log(m) – Log(s) = LSI*, where *m* is the measure obtained from a bone and milimetra, u skladu s kriterijima koje je postavila von den Driesch.[20]

Promjene u spolnom sastavu stada ovaca najbolje se utvrđuju biometrijski usporedbom duljine i širine kostiju. Iz studija Davisa na modernim populacijama šetlandskih ovaca vidi se da su razlike u spolovima jače izražene u duljini nego u širini kostiju, posebno kod kastrata.[21] Vrijednosti veličine za kosti ovaca preračunate su u vrijednost LSI (*Log Standard Index*) prema izračunu *Log(m) – Log(s) = LSI*, gdje je *m* veličina kosti, a *s* odgovarajuća veličina kod životinje srednje veličine.[22]

Usporedbom ovih vrijednosti, na slici 3. i slici 4., zaključuje se da je tjelesna veličina ovaca s Rata uglavnom konstantna u svim razdobljima (slika 4). Međutim, omjeri spolova unutar stada bitno su promijenjeni tijekom srednjega brončanog i željeznog doba (slika 3), ukazujući da je u tim razdobljima veći udio mužjaka doživio odraslu dob. Porast udjela mužjaka (posebno kastrata) koji su preživjeli do zrelosti vidljiv je kod stada koja su usmjerena iskorištavanju vune.[23] Nije poznato jesu li u tim razdobljima u Dalmaciji ovnovi kastrirani, iako mogućnost za takvu

19 Halstead 1996, p. 25; Halstead 1999, p. 150.
20 Von Den Driesch 1976.
21 Davis 1996; Davis 2000.

20 Von Den Driesch 1976.
21 Davis 1996; Davis 2000.
22 Meadow 1999; Korištene mjere veličine za životinju srednje veličine mogu se naći kod Sanford 2012. i Gaastra, Sanford, u tisku.
23 Halstead 1999; Greenfield 2006.

s is the corresponding measure from a standard animal.[22] By comparing these variables in Fig. 3 and 4 we can see that sheep body size from Rat remains fairly constant over the periods studied (Fig. 4) but that the sexual proportions of herds change markedly during the Middle Bronze and Iron Ages (Fig. 3), indicating a far greater proportion of males surviving into adulthood in these periods. An increase in adult male survivorship (particularly of castrates) is seen elsewhere in herds being exploited more intensively for wool.[23] It is unknown if sheep would have been castrated in Dalmatia in this period, although the practice is suggested for contemporaneous sites in nearby regions.[24] This fluctuating interest in wool at Rat corresponds with indications of weaving and textile production at the hillfort, with finds of loom weights appearing from the Middle Bronze Age.

In the Late Bronze Age this preference for young adult and sub-adult animals changes again to include the same dominance (30%) of infant and juvenile animals seen in the earlier Bronze Age before shifting back in the Iron Age to focus once again on older animals. This increase in infant and juvenile slaughter is coupled with a decrease in adult male survivorship, suggesting management practices once again orientated more towards meat and milk as in the Early/Middle Bronze Age. This oscillating management strategy, although in no period corresponding to the modern market-driven culling profiles developed by Payne,[25] indicates the changing importance of primary vs. secondary products to the management of sheep at Rat.

Conclusions

The fauna from Gradina Rat have provided a key example of animal management practices over the course of the Bronze and Iron Ages in the eastern Adriatic, showing oscillating degrees of specialization in management strategies for secondary products in sheep. Animal management at Rat was not a static activity, but was rather one which can be seen to have varied over time as the interactions and needs of the community changed. During the Middle Bronze Age a significant shift occurs towards the management of sheep for wool. At this time hillfort development in the area increases, and Rat hillfort displays evidence of textile manufacture. In the Late Bronze Age this

22 Meadow 1999. Measurements for the standard animals used can be found in Sanford 2012 and Sanford Gaastra 2014.

23 Greenfield 2006; Halstead 1999; Rougemont 2004.

24 Halstead 1999.

25 Payne 1973.

praksu postoji na nalazištima u obližnjim regijama.[24] Porast zanimanja za vunu na Ratu odgovara dokazima tkanja i proizvodnje tekstila na gradini, s najstarijim primjercima utega tkalačkog stana iz slojeva srednjega brončanog doba.

U kasno brončano doba ovaj se naglasak na mlađe odrasle i gotovo odrasle jedinke ponovno mijenja kako bi uključio dominaciju (30 %) nezrelih i mladih jedinki koja je već zabilježena u rano brončano doba. Prema željeznom dobu naglasak se ponovno prebacuje na odrasle jedinke. Taj porast u udjelu klanja nezrelih i mladih jedinki poklapa se sa smanjenjem stope preživljavanja mužjaka do odrasle dobi, što pokazuje da se upravljanje stadom opet orijentiralo na proizvodnju mesa i mlijeka kao u rano/srednje brončano doba. Ove oscilacije u upravljanju stadom, iako ni u jednom razdoblju ne odgovaraju modernim tržišnim uzorcima selekcije koje je predložio Payne,[25] pokazuju promjene u važnosti primarnih i sekundarnih proizvoda za upravljanje ovcama na Ratu.

Zaključak

Fauna s gradine Rat pruža ključni primjer upravljanja životinjskim resursima tijekom brončanoga i željeznog doba na istočnom Jadranu te u strategijama upravljanja pokazuje oscilirajuće stupnjeve specijalizacije k sekundarnim ovčjim proizvodima. Upravljanje životinjskim resursima na Ratu nije bilo statično, već se mijenjalo kroz vrijeme, ovisno o kontaktima i potrebama zajednice. Tijekom srednjega brončanog doba dogodio se značajan pomak prema uzgoju ovaca zbog vune. U to se vrijeme povećava razvoj gradina na tom području, a na Ratu se pojavljuju dokazi tekstilne manufakture. U kasno brončano doba taj se trend kroz promijenjenu stočarsku strategiju opet vraća prema proizvodnji mesa, mlijeka i mliječnih proizvoda, što pokazuje da trgovina vunom i tekstilom te kontrola proizvodnje više nisu bile važni čimbenici na gradini.

Ta uočljiva promjena u upravljanju stadom i povratak počecima specijalizirane proizvodnje iznenađuje, ali ništa više od povratka prema proizvodnji vune u željezno doba. Tek treba vidjeti zbog čega ta razdoblja nude dokaze specijalizirane proizvodnje koje nije bilo u kasno brončano doba te zamjećuje li se taj uzorak na širem području. U svakom slučaju, temeljite promjene u upravljanju stadom koje se vide na Ratu, pokazuju kojom se brzinom stočarske strategije mogu mijenjati kako bi zadovoljile trenutačne interese i uvjete. Svi daljnji zaključci još uvijek zahtijevaju pomne krono-

24 Halstead 1999.

25 Payne 1973

pattern shifts back to include meat and milk production in a diversified herding strategy, suggesting that the importance of trade in wool, textiles, or control of production was no longer an important feature at the hillfort.

This distinct change in herd management and the reversal of beginnings of specialized production is surprising, but no more so than the reversal in the Iron Age back towards wool production. It remains to be resolved why specifically these periods demonstrate evidence of specialized production not seen in the Late Bronze Age, or if this pattern occurs throughout the region. However, the drastic shifts in herd management seen at Rat provide a reminder of the speed at which pastoral management practices can change to suit current interests and conditions, requiring careful chronological comparison of broader regional and temporal trends in prehistory.

Analysis of Worked Bone Artefacts

Emanuela Cristiani

The Bronze and Iron Age levels of Gradina Rat yielded two osseous artifacts: (1) a bevel-end tool made from the entire metatarsal of *Ovis aries* with complete proximal articulation and (2) a flat pointed tool made from the half metapodial of *Ovis/Capra* with a partial remaining proximal articulation (Fig. 5). Both bone tools have been analysed in order to reconstruct the modality of their production and use.

Methods of Analysis

The two worked bone tools have undergone a morphological and techno-functional study using both low- and high-magnification analyses.

Osseous artefacts have been categorized on the basis of the morphology of the active part (i.e. pointed, edged) and from their metrical information. For the morphological definitions I have referred to the Committee of Nomenclature of Prehistoric Bone Industry.[26]

Technological and functional traces have been identified by the naked eye and subsequently through a stereoscopic microscope Leica MZ12.5 (magnification range from 10x to 100x), as well as an incident light metallurgical microscope Leica DC2500 (magnification range from 50x to 200x) and Hitachi TM-3000 Scanning Electron Microscope (SEM). The interpretation of the technological and use-wear traces on the

26 Camps-Fabrer, Ramseyer, Stordeur 1990; Camps-Fabrer, Ramseyer, Stordeur 1998.

loške usporedbe regionalnih trendova na ovom polju tijekom vremena.

Analiza obrađenih koštanih alata

Emanuela Christiani

U brončanodobnim i željeznodobnim slojevima gradine Rat do sada su pronađene dvije koštane alatke: (1) alatka s koničnim završetkom načinjena od čitave metatarzalne kosti ovce (*Ovis aries*) s cjelovitim proksimalnim okrajkom i (2) alatka s plosnatim završetkom načinjena od polovice metapodija malog preživača (*Ovis*/*Capra*) s djelomično sačuvanim proksimalnim okrajkom (slika 5). Obje su alatke analizirane kako bi se rekonstruirali postupci njihove proizvodnje i uporabe.

Metode analize

Dvije koštane alatke proučene su morfološki i tehničko-uporabno uz malo i veliko povećanje mikroskopa.

Koštani predmeti kategorizirani su na osnovi morfologije završetka i njihovih dimenzija. Morfološke kategorije referiraju se na Odbor za nomenklaturu prapovijesne koštane industrije.[26]

Tehnološki i funkcionalni tragovi su identificirani golim okom, a potom stereoskopskim mikroskopom *Leica* MZ12.5 (s uvećanjem od 50x do 200x), te s reflektirajućim metalurškim svjetlosnim mikroskopom *Leica* DC2500 (s uvećanjem od 50x do 200x) i *Hitachi* TM-3000 *Scanning Electron Microscope* (SEM). Interpretacija tehnoloških tragova i tragova uporabe na arheološkim artefaktima izvedena je uz pomoć: 1. referentne kolekcije eksperimentalnih tehnoloških tragova povezanih s uporabom metala za oblikovanje koštanih alatki i 2. kriterija definiranih u literaturi.[27]

Alatka s koničnim završetkom

Alatka potječe iz željeznodobnog konteksta, a načinjena je od čitave metatarzalne kosti ovce koja je pri izradi zadržala cjeloviti proksimalni okrajak (slika 5b, 3 i 4). Radni dio ovog alata s koničnim završetkom izrađen je odstranjivanjem distalne epi-

26 Camps-Fabrer, Ramseyer, Stordeur 1990; Camps-Fabrer, Ramseyer, Stordeur 1998.

27 Za tehnološka tumačenja Averbouh and Provenzano 1999; Cristiani and Alhaique 2005; Christidou 2008; za proučavanje tragova korištenja Maigrot 1997; Christidou 1999; Christidou 2008; Legrand 2007.

archaeological artefacts has been carried out using: 1) reference collection of experimental technological traces related to the use of metal for shaping bone tools 2) criteria defined in the literature.[27]

Bevel-End Tool

The Iron Age contexts yielded a bevel-end tool, made from an entire *Ovis aries* metatarsus while retaining the proximal articular surface (see Fig. 5b, 3 and 4). The active part of this bevel-end tool has been produced by eliminating the distal epiphysis of the metatarsal through indirect percussion, as suggested by an impact cone visible on the ventral side of the bevel. Subsequently, all the surfaces of the tool have been regularized by scraping, using a metal tool. Use-wear traces are developed on both the distal and the proximal part of the tool. The distal beveled-end shows compression marks and flat modification of the outline, and an invasive rounding along the whole bevel, which have been produced by using of the beveled tool with a longitudinal movement on a medium hard material (see Fig. 5,3 and 5,4). The enlargement of the natural hole of the proximal articulation indicates that a shaft has been inserted inside in the proximal part of the bone while the tool was used.

Flat Pointed Tool

The Early Bronze Age contexts of Gradina Rat yielded a flat pointed tool manufactured from an *Ovis/Capra* metapodial half with partial retention of the proximal articular surface (see Fig. 5*a*). This flat pointed tool does not show traces of manufacture techniques (*debitage*) as they have been erased during the subsequent shaping phase. Like the other bone tool from Rat, this latter stage of the manufacture has been carried out by scraping with a metal tool (Fig. 5,1). The pointed end has also been regularized by means of transversal abrasion (Fig. 5,2). Although rounding traces located on the distal part of the point suggest the tool has certainly been used, high developed surface exfoliation and roots marks have not allow to identify diagnostic use-wear traces related to the specific function of the tool.

fize metatarzalne kosti neizravnim udaranjem, na što ukazuje udarni konus vidljiv na ventralnoj strani kosine. Nakon toga je sva površina alatke izravnana struganjem pomoću metalnog alata. Tragovi korištenja vide se na distalnom i proksimalnom završetku alata. Distalni, konični dio pokazuje tragove pritiska i promjenu prema zaravnjenju, kao i drastično zaobljavanje duž cijelog konusa, što je uzrokovano korištenjem ovog alata po dužnim pokretima na srednje tvrdom materijalu (slika 5, 3 i 4). Povećanje prirodnog otvora na proksimalnom okrajku pokazuje da je prilikom korištenja alata u proksimalni dio kosti bio umetnut držak.

Alatka s plosnatim završetkom

Iz slojeva horizonta ranoga brončanog doba na Ratu potječe alatka s plosnatim završetkom izrađena od polovice metapodijalne kosti malog preživača (*Ovis*/*Capra*) s djelomično zadržanom površinom proksimalnog okrajka (slika 5a). Alatka ne pokazuje tragove izrade (*debitage*) jer su uklonjeni naknadnim oblikovanjem. Kao i druga koštana alatka s Rata, kasniji stupanj izrade izveden je struganjem metalnim alatom (slika 5, 1). Zašiljeni kraj je također oblikovan transverzalnom abrazijom (slika 5, 2). Iako tragovi zaobljivanja na distalnom kraju šiljka sugeriraju kako je alatka bez sumnje korištena, uznapredovalo ljuštenje površine i tragovi korijenja ne dopuštaju prepoznavanje tragova korištenja i trošenja vezane uz određenu uporabu alatke.

27 For the technological interpretations: Averbouh, Provenzano 1999; Cristiani, Alhaique 2005; Christidou 2008; for the study of the use-wear traces Maigrot 1997; Christidou 1999; Christidou 2008; Legrand 2007.

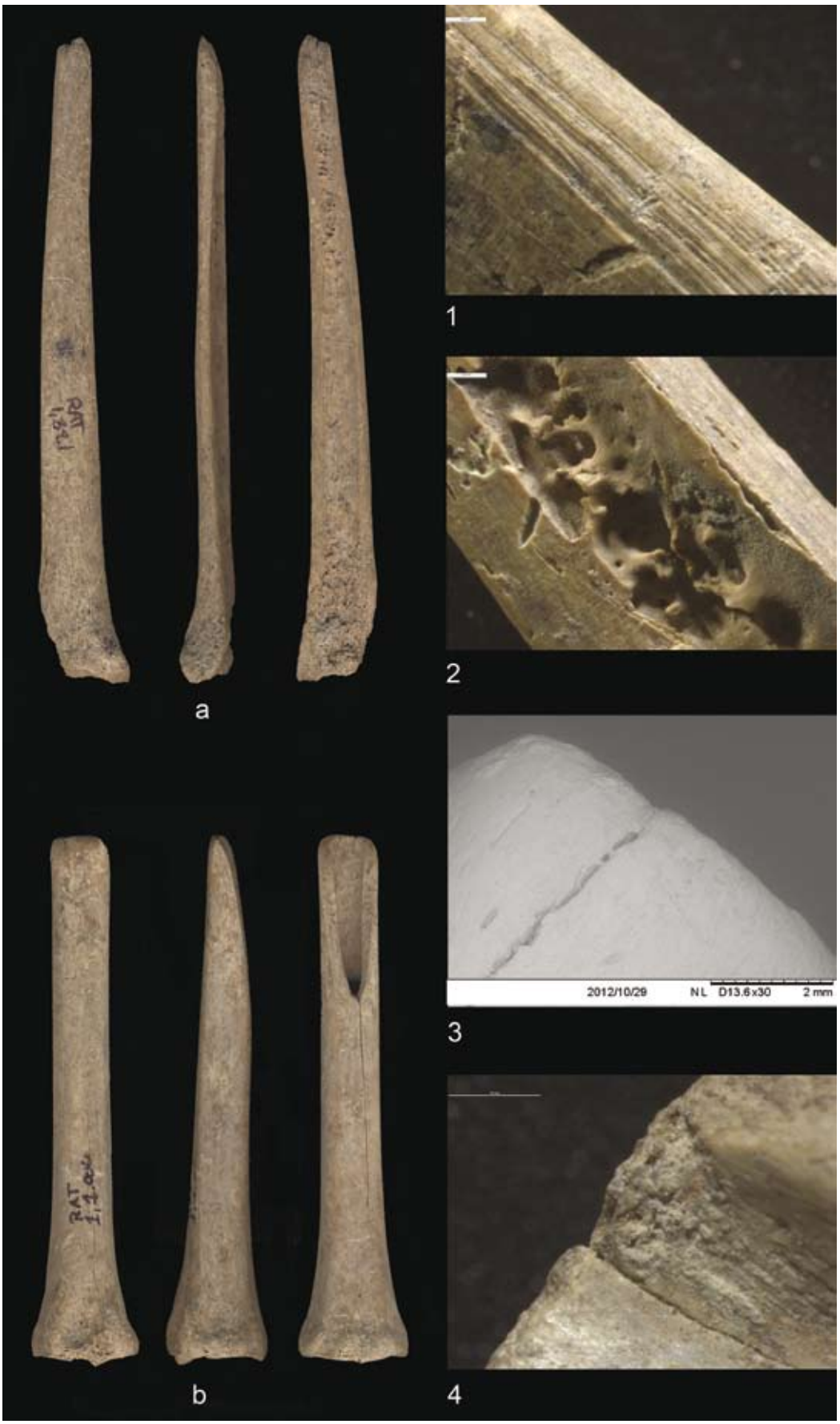

Fig. 5. The flat pointed tool (a) showing metal tool marks (1) and transveral abrasion (2) and the bevel-end tool (b) showing compression marks to the bevel (3 and 4)
Sl. 5. Alatka s plosnatim završetkom (a) s tragovima upotrebe metalnog oruđa (1) i transverzalne abrazije (2) te alatka s koničnim završetkom (b) s tragovima pritiska na završetku (3 i 4)

Iron Age

Ovis aries

Scapula	GLP	LG	BG	Phalanx 1	GLpe	Bp	SD	Bd	Metacarpal	Bp	Dp
	25.0	22.0	18.0		31.0	12.0	10.0	11.5		21.0	15.0
Phalanx	GL	19.0	18.0		39.5	14.0	11.5	13.0		22.0	16.0
2	Bp	11.0	10.0		36.0	13.0	11.5	13.0	Tibia	Bd	Dd
	SD	8.0	7.0		29.5	11.0	8.5	10.0		22.5	17.0
	Bd	8.5	7.0		29.0	10.0	7.5	8.5		26.0	20.0
Humerus	BT	BT			29.5	10.0	7.0	9.0		22.5	17.0
	27.0	26.0								22.5	18.0

Capra hircus

Scapula	GLP	LG	BG	Phalanx 1	GLpe	Bp	SD	Bd	Tibia	Bd	Dd
	31.0	24.0	21.0		44.5	13.5	10.5	13.5		24.5	18.0
	31.0	24.0	20.5	Femur	Bp	42.0	DC	20.0			

Ovis/Capra

Calcaneus	GL	44.0		Radius	Bp	27.0	BFp	25.5

Cervus elaphus

Tibia	Bd	Dd		Phalanx 1	GLpe	Bp	SD	Bd
	24.0	16.5			48.5	30.0	14.0	18.5

Late Bronze Age

Ovis aries

Scapula	GLP	SLC	LG	BG	Phalanx 1	GLpe	Bp	SD	Bd	Femur	Bp	DC
	27.5	17.0	22.0	18.0		33.0	11.0	9.2	9.5		38.0	18.0
	29.0	20.0	22.5	20.5		30.0	10.5	8.0	Calcaneus		GL	55.0
	33.0	21.0	25.0	21.0	Astragalus	GLl	GLm	Dl	15.0	18.0	Metacarpal	
	28.0	18.0	23.5	18.0		27.0		18.6	14.0	16.0	Bp	23.0
	31.7	21.0	25.0	21.0		29.0	26.7	16.0	12.0	14.5	Dp	16.0
Phalanx 2	GL	Bp	SD	Bd		26.0	25.3	14.5	Humerus		SD	BT
	24.0	10.5	7.5	8.5		23.0	22.0	12.5			11.5	23.5
	21.5	11.5	8.5	8.5								25.0
	22.2	11.5	8.8	9.0	Metatarsal	GL	Bp	Dp	SD		Bd	Dd
	20.0	10.5	7.2	8.0		113.0	15.5	16.0	8.0		20.0	13.5

Radius	GL	Bp	BFp	SD	Bd	BFd
	125.5	25.0	23.0	13.0	23.0	20.0

Capra hircus

Astragalus	GLl	GLm	Dl	Dm	Bd	Scapula	GLP	SLC	LG	BG	Tibia	
	26.0	24.2	13.0	14.0	17.2		33.0	20.0	25.0	23.0	Bd	Dd
Phalanx 2	GL	Bp	SD	Bd	Phalanx 1	GLpe	Bp		SD	Bd	23.0	16.0
	21.0	11.5	9.0	9.0		36.0	14.0		11.4	12.5		
	23.0	11.3	8.3	9.5								

Sus domesticus	*Bos Taurus*

Phalanx 2	GL	Bp	SD	Bd	Astragalus	GLl	GLm	Dl	Dm	Bd
	21.0	16.0	13.0	15.0		53.0	48.0	30.0	27.5	35.5

Canis familiaris									*Cervus elaphus*			*Capreolus capreolus*		
Femur	Bp	38.0	BTr	23.5	DC	18.0	SD	13.0	Calcaneus	GL	59.0	Humerus	BT	23.0

Middle Bronze Age

Ovis aries

Phalanx 1	GLpe	Bp	SD	Bd	Astragalus	GLl	Glm	Dl	Dm	Bd	Humerus	
	34.0	10.5	8.5	10.0		28.0	26.0	14.0	16.0	18.0	Bd	BT
	31.5	10.5	8.0	9.5	Metacarpal	GL	Bp	Dp	SD	CD	28.0	27.0
	39.0	12.0	10.0	12.0		109	23.0	16.0	15.0	42.0	29.0	28.0
	29.5	10.0	8.0	9.0								

Phalanx 2	GL	Bp	SD	Bd	*Capra hircus*			*Ovis/Capra*			
	25.0	11.0	8.0	9.0	Radius	Bd	BFd	Phalanx 3	DLS	Ld	MBS
	23.0	12.0	10.0	10.5		28.0	26.5		22.0	19.0	4.5
	25.0	11.0	7.5	8.5	*Cervus elaphus*						
	18.0	9.0	5.0	8.0	Radius	Bp	25.0	BFp	22.0		

Early/Middle Bronze Age

Ovis aries

Phalanx 1	GLpe	Bp	SD	Bd	Scapula	GLP	LG	BG	Tibia	Bd	Dd
	32.0	11.5	9.5			24.0	19.5	15.0		22.0	16.0
	31.0	11.5	9.0	10.5		29.5	24.0	19.0			
	32.0	10.5	8.0	10.0	Astragalus	GLl	Glm	Dl	Dm	Bd	
	34.0	12.0	9.5	12.5		29.0	26.5	14.5	15.5	17.0	
	31.0	10.5	9.0	9.5	Humerus	Bp	Dp	Bd	BT		
	32.0	10.5	8.5	10.0		35.0	42.5				
	36.0	12.0	11.0	12.0				25.0	23.5		
	32.0	11.0	9.0	10.0							

Capra hircus

Scapula	GLP	LG	BG		Phalanx 1	GL	Bp	SD	Bd	
	31.5	26.5	22.0			38.0	11.5	8.5	11.0	
	30.0	24.5	20.0			36.0	13.5	11.0	13.0	
						39.5		9.0	11.5	

Ovis/Capra

Phalanx 2	Gl	Bp	SD	Bd	Metacarpal	Bp	Dp	Metatarsal	Bp	Dp
	22.0	9.5	7.5	10.0		19.0	13.5		18.0	17.0

Astragalus	GLl	GLm	Dl	Dm	Bd	Phalanx 3	DLS	Ld	MBS
	23.5	22.5	13.0	13.5	16.9		32.0	25.5	5.5
							25.5	19.5	4.5

Bos Taurus

Phalanx 1	GLpe	Bp	SD	Bd	Tibia	Bd	Dd
	44.5	24.5	20.5	22.0		53.0	49.0
	50.0	27.0	22.0	25.0			

Capreolus capreolus

Phalanx 1	GLpe	Bp	SD	Bd	Radius	Bp	BFp
	30.5	10.0	8.0	9.0		26.0	24.0

Cervus elaphus											
Phalanx 1	GLpe	44.0	Bp	14.0	SD	10.5	Bd	14.0			
Early Bronze Age											
Ovis aries											
Astragalus	GLl	GLm	Dl	Dm	Bd	Metacarpal	Bp	Dp	SD	Tibia	
	26.0	24.2	15.0	15.5	16.0		20.0	13.8	11.5	SD	13.0
	25.2	24.2	15.0	16.0	17.0	Metatarsal	Bp	Dp	SD	Bd	23.5
Phalanx 2	GL	Bp	SD	Bd			18.7	18.5	10.5	Dd	19.2
	21.0	11.0	8.2	9.0		Astragalus	GLl	GLm	Dl	Dm	Bd
Ovis/Capra							26.0	24.2	15.0	15.5	16.0
Phalanx 3	DLS	26.0	Ld	21.5			25.2	24.2	15.0	16.5	17.0
Capra hircus											
Phalanx 1	GLpe	37.5	Bp	14.5	SD	11.5	Bd	13.0			
Sus domesticus											
Radius	Bp	Dp		Astragalus	GLl	GLm	Dl	Dm		Bd	
	29.0	20.0			40.5	37.5	20.3	22.0		25.5	
Lepus europaeus											
Scapula	GLP	BG	Humerus		SD	Bd	Dd		Radius	Bp	Dp
	11.5	10.2			5.5	11.1	8.5			8.9	5.8

Table 3. Biometric tables for Gradina Rat. All measurements were taken following von den Driesch (1976) and are given in mm.
Tablica 3. Biometrijske tabele za gradinu Rat. Sve mjere su uzete kako navodi von den Driesch (1976) te su izražene u mm.

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